

How a Thrilling Circus Feat Teaches a Scientific Law



The bicycle "loop" presents a most interesting demonstration of a great scientific principle, which plays its part in preventing the earth from dropping into the sun, and the moon from being precipitated upon the earth, no less than in keeping the rider and his wheel from falling to the ground when he hangs, head downward, in mid-air, at the top of the loop.

Centrifugal force is the agent concerned in this seemingly miraculous feat, a force that has many appliances in everyday life, some of which—like the swinging of a bucketful of water around the head without spilling—astonish the uninitiated, while others are so familiar that nobody stops to think of them. But when applied in the case now under consideration, centrifugal force presents itself in a most sensational form.

Yet, thrilling though it is to watch the bold rider defying gravitation, like a fly on the ceiling, without anything except his motion to hold him in place, the natural law that he obeys is extremely simple and perfectly certain in its operation. If he observes all the requirements of that law it will never fail him; so that his safety depends entirely upon himself.

He must develop a centrifugal force great enough to counterbalance his weight when he is at the top of the circle. Mathematics, knowing the size of the loop, is able to tell him how to develop the force needed. The force depends upon the velocity with which he moves. He acquires that velocity, not by pedaling, but by riding down a steep slope. How high must the starting point be? A general rule, applying to all such cases, is that the elevation of the point from which he starts must be to the elevation of the top of the loop in a ratio exceeding that of five to four.

The air resistance and the friction must all be carefully allowed for, and this is the business of the engineer who plans the apparatus. Accordingly, if the loop is twenty feet high, the starting platform must be more than twenty-five feet in height, and the acquired velocity must exceed that named above. Of course, the loop may be less than twenty feet in height and then all the other dimensions will be proportionately reduced.

It is probable that, in the actual case considered, the velocity with which the rider arrives at the bottom of the slope and begins the ascent of the circular loop is at least thirty miles an hour. This velocity immediately and rapidly falls off as he commences the ascent of the steepening curve, so that when he reaches the top he is moving only fast enough to impart a centrifugal force exceeding his weight (or the effect of gravitation) by a margin sufficiently large to insure his safety.

As the bicycle strikes the curve of the loop and begins to ascend, the wheels are pressed against the track with tremendous force and the rider is pitching forward with an energy which only practice and trained muscles can enable him to withstand. It is as if the weight of half a dozen men had suddenly been thrown upon him and his machine. If we estimate the actual weight of bicycle and rider at 200 pounds, then it can be shown that their combined weight, or rather their pressure upon the track, owing to centrifugal force, becomes, as they begin the ascent of the loop, more than a thousand pounds. And this, too, at the minimum speed theoretically required to carry them around. In practice this pressure may be considerably greater.

Here, then, would seem to be a point of special danger. The rider must be prepared for this instantaneous increase of virtual weight. He has to keep his nerves steady and his head

INTERESTING DEMONSTRATION OF CENTRIFUGAL FORCE

clear, and must retain control over his muscles in order to hold his balance and guide his wheel. But this is only a beginning.

As he rises, in a moment he is going straight upward, and the pressure swiftly diminishes. When he whirls across the overhead portion of the track and reaches the center of the top of the curve his head is down, his feet are up and his bicycle is on top of him. They are sustained only by centrifugal force. Gravitation is pulling them straight downward with a force of 200 pounds. If the centrifugal force but slightly exceeds gravitation at this point, the rider, if he has time to analyze his sensations, must feel almost as if he were floating like a feather, deprived of nearly all weight.

This is the critical point. If the calculations have been correct, there will be enough velocity remaining when the top is reached to counterbalance gravitation, and, even if the excess is slight, the rider and his wheel will pass on and, once over the center, they are henceforth secure against a fall. They will remain on the track during the downward journey. Theoretically, with a loop 20 feet in diameter, and neglecting resistance, they must reach the top with a velocity of nearly six feet a second. In practice the velocity would have to be considerably greater.

But consider the effects upon mind and body of the rapid changes of apparent weight that the rider undergoes. At the bottom of the loop his apparent weight was instantaneously increased to a prodigious amount, almost crushing him down upon the handle bar. This lasts but a moment, and then, again almost instantaneously, his weight drops upon him, and at the top of the loop he seems to weigh comparatively little, but only to be a second later again bent over the handle bars by the pushing pressure, as the wheel, having gained momentum, swings upon the slope leading to the stopping place.

It is apparent, from what has been said, that the principal peril involved is personal in its origin. The rider must not allow his head to swim, or his muscles to relax their control over the wheel. Given perfect self-command, the danger is reduced to a minimum.

The same force that carries the rider around his twenty-foot circle would carry him, through empty space, completely around the earth, if he could start from a mountain top with a velocity of five miles, instead of a few yards, per second. The needed velocity varies with the radius of the circle traversed.—Prof. Garrett P. Serviss in Hearst's Chicago American.

ENCOURAGEMENTS TO MATRIMONY

Cases Where Slight Provocation Caused an Epidemic.

It would seem that at times matrimony only needs to be encouraged to become epidemic. The mayor of a town in Southern France, not satisfied with the manner in which his young people were shying at marriage, offered a reward of 100 francs to every couple under the age of 24 who were joined in wedlock during his term of office. It cost the good mayor many hundreds of dollars, but the scheme

worked, and young unmarried people became scarce in the community.

When the marriages in a certain Alsatian town fell below the average the authorities hit upon a curious inducement for tight couples to seek the matrimonial altar. They publicly announced that all people who married within a certain time would be exempt from local taxation for a period of five years. A marriage fever swept through the town at once.

A well-known Austrian nobleman was anxious to encourage matrimony among the peasants on his estate. He undertook to provide every bridegroom with tobacco for life and every bride with a pair of gloves once a year as long as she lived. This generous offer acted like a charm, and soon there was scarcely an unmarried man on the estate. Nearly every eligible male was in the enjoyment of domestic bliss.

ANSWERS BY PRECOCIOUS PUPILS

Some Humorous Replies to a Number of Simple Questions.

One of the greatest things that Columbus discovered was that he had not the faintest idea that he had discovered America.

Washington said to the soldiers at Valley Forge that they are whole need not a physician.

The Chesapeake attacked the Shannon and drove her up the Shenandoah Valley, then the Shannon attacked the Chesapeake and the war ended in a battle.

At the battle of New Orleans three of the British officers were killed, one of them mortally.

The Romans left the Britons low spirited and crest-fallen.

The Parthenon was used as a powder magazine during the Trojan war.

The outline of Greece is very rugged, surrounding all the country or nearly all.

The Persians hurried across the Hellespont, burning it behind them.

A great many of our authors were born there, Hawthorne, Thoreau, and the battle of Concord.

Dickens married, but not successfully.

The chief elements of English are Anglo and Saxon.

The three great literary works of the Hebrews were the Translation of the Old Testament into the New and several great histories, these they wrote on papyrus paper made from that weed.

Cognate—born together. Example: Cats are cognate. Cats cognate together.

Append—hang to. Example: Ulysses appended to the raft.

She returned his affection as much as she thought prudent, considering the hasty temper of her brother.

The president of the society was magnanimously elected.

God tempers the wind to the short-horned lamb.—Christian Endeavor World.

Wealthy Women Poor Payers.

A woman examined in a New York bankruptcy court last week said she had failed in her livery business because, while in a fashionable (or, as she said "swell") neighborhood, her patrons didn't pay her. She said she lost \$75,000.

The Sultan's Harem

Lives of Luxury Led by the Favorites of the Present Ruler of Turkey

The number of wives maintained by the sultan of Turkey is estimated at between 300 and 400. These wives are taken from the prominent families of the empire, and the position is much sought after, as it enables the holder to exercise a powerful influence in behalf of her relatives and friends. When

obsolete. The traditional harem in which hours sit around upon silk rugs with their legs crossed and play guitars and eat sweetmeats exists only in the imagination. The women live just like any other royal family, except that they are not allowed to receive company or enter society, and when they leave the palace they must wear heavy veils.

The mosque of Omayyade is one of the largest in the world, being about 500 feet long and 350 feet broad, and opens into a vast quadrangle with innumerable columns, Saracenic arches and curious structures of the oriental type. One, called "the Dome of the Water Spout," covers the fountain at which the faithful perform their ablutions before entering the sanctuary. Another, called "the Dome of the Treasure," is a perfect Corinthian structure for library purposes, and it is said to be occupied with a large collection of sacred books and records centuries old; but no Christian is allowed to inspect them.

The mosque is divided into three aisles by rows of columns which extend the whole of its vast length. The columns are twenty-four feet high, of the choicest marble, with beautifully carved Corinthian capitals. The material of the walls is various colored marbles from the finest quarries of the ancient world, and the upper part of the walls and the dome are enriched with tiles and mosaics. It is said that 1,200 artists were engaged for thirty years in the decoration. In the center of the mosque four massive pillars support a dome 120 feet high and 100 feet in circumference, whose surface is embellished with mo-



A Turkish Girl of Good Family.

a rich pasha wants to secure the favor of the sultan he offers him one of his daughters with a suitable dowry as a wife, and if she is accepted it is a sign of friendliness as well as a mark of distinction. When the governor of the Circassians' province, which is said to have the most beautiful women in Turkey, wishes to please his imperial master he will send him a handsome young wife as a gift, or when any of his subordinates discover a young woman of remarkable attractions they secure her for the royal harem.

The ladies of the harem are called sultanas. They enter as slaves, and the younger become the servants of the elder and attend upon them until they are promoted. If the sultan takes a fancy to any one of his wives her fortune is made, for she is rapidly promoted, her allowance for dresses and jewels is increased, and if she becomes a mother she can live apart from the rest, as becomes a princess. All children born in the harem, whether of free women or slaves, are legitimate and of equal lineage and may inherit the throne if they ever become the head of the family, for, according to custom, the succession is vested in the oldest male of the royal family, whether he be son, brother or cousin of the reigning sovereign.

Ladies of the imperial harem almost without exception wear European dress. Only the most recent arrivals, girls who come from the interior of the country, retain the native costume. The ladies have French maids and order their gowns and hats in Paris. Every now and then a French modiste or milliner arrives in Constantinople with samples for the inspection of the sultanas, from whom she receives very large and liberal or-



Favorite of the Sultan's Harem.

sales and frescoes formed of texts from the Koran in the beautiful calligraphy which the Arabs delight to display. The marble floor is covered with rugs of the rarest texture. The pulpit is of alabaster and the fretwork of its sides represents the highest skill of oriental artists. The "mukam" or shrine in the center is an



THE SULTAN AT THE MOSQUE.

ders. Although they are seldom seen by men, the inmates of the harem have all the feminine instincts and there is a great deal of rivalry among them. We saw one of the sultan's favorite wives and her daughter driving the other day, accompanied by a negro eunuch and a military escort, writes William E. Curtis in the Chicago Record-Herald. They were dressed like any other ladies, but were closely veiled so that their features could not be distinguished.

The apartments of the harem are equipped with European furniture. Meals are served in European style and the cooks are French. The French language is spoken generally among the sultanas and they read French novels. Turkish customs are almost

exquisite piece of brass and tile work. Both the metal and porcelain are said to be unsurpassed.

Old Gentleman Knew Mankind.

Attorney-General Knox says that when he left college and went home with his diploma he was the proudest young man in the land. His father, a country banker, looked over the diploma and said: "Young man, if you know half as much when you are 60 years old as you think you know now you will be the brainiest man this world has ever produced."

A great many men who express a willingness to die for the old flag always let their wives carry in the coal